

# Image Smoothing and Sharpening

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# Introduction

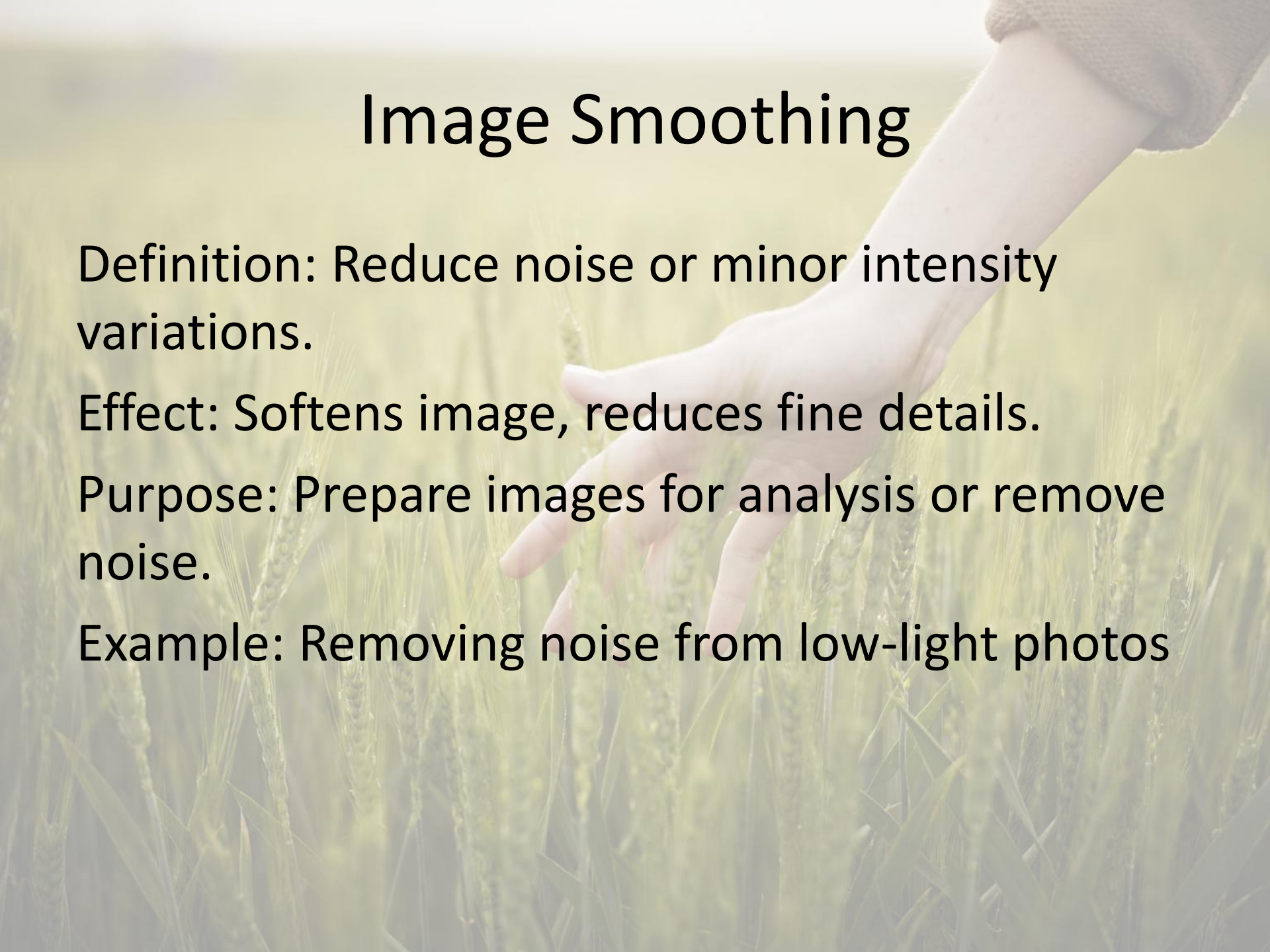
Image processing improves visual quality.

Two main techniques:

1. Smoothing – reduces noise, softens images
2. Sharpening – enhances edges and details

Applications: photography, medical imaging, industrial inspection, computer vision

# Image Smoothing

A hand reaching out towards a field of wheat, symbolizing smoothing or softening.

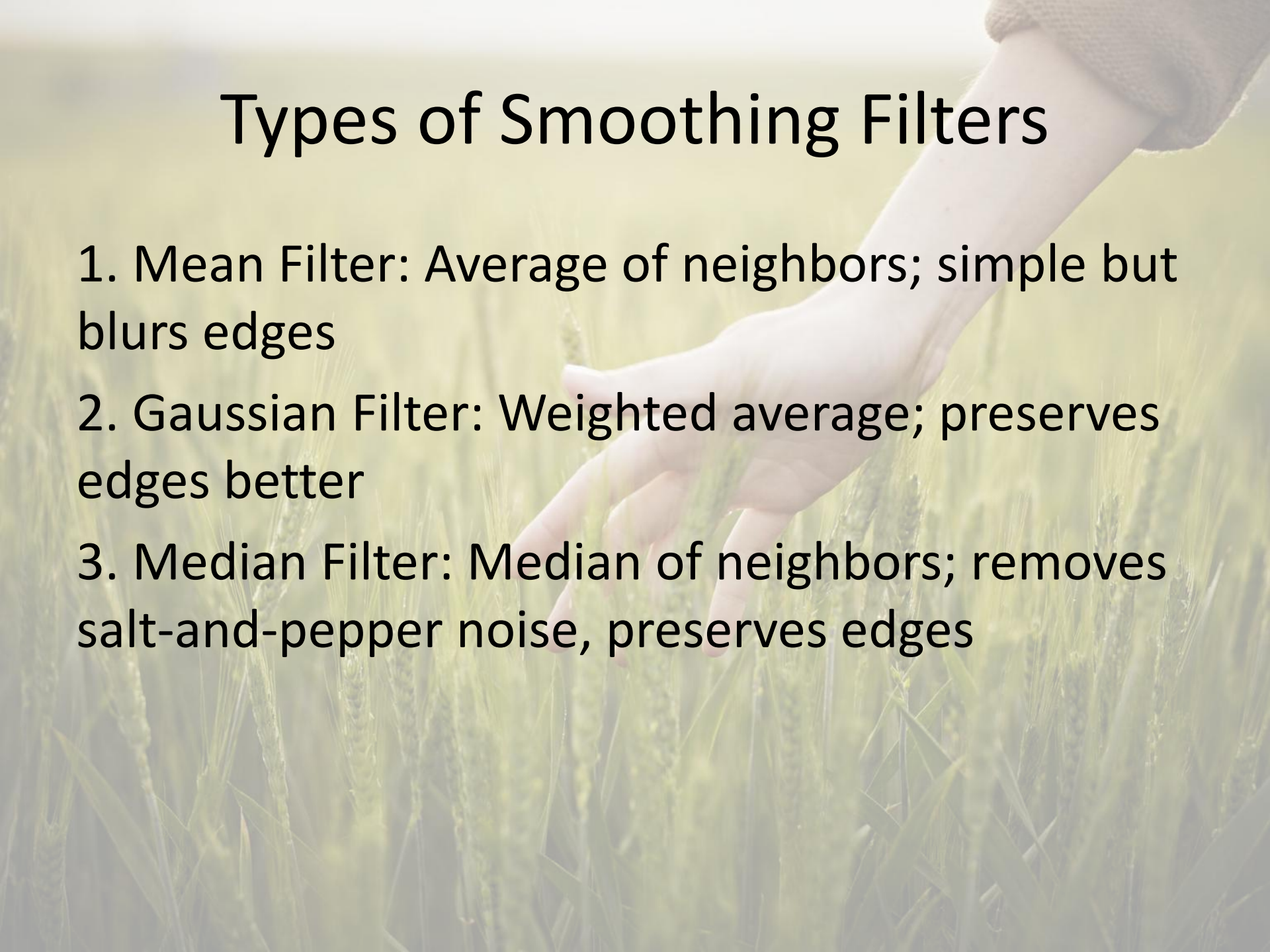
**Definition:** Reduce noise or minor intensity variations.

**Effect:** Softens image, reduces fine details.

**Purpose:** Prepare images for analysis or remove noise.

**Example:** Removing noise from low-light photos

# Types of Smoothing Filters

A hand in a light-colored sleeve reaches out from the right side of the frame towards a field of golden wheat stalks. The background is a soft-focus field of wheat under a bright, hazy sky.

1. Mean Filter: Average of neighbors; simple but blurs edges
2. Gaussian Filter: Weighted average; preserves edges better
3. Median Filter: Median of neighbors; removes salt-and-pepper noise, preserves edges

# MATLAB Example: Smoothing

```
I = imread('example.jpg');  
I_gray = rgb2gray(I);  
h = fspecial('average',[5 5]);  
mean_img = imfilter(I_gray,h);  
imshowpair(I_gray, mean_img,'montage');  
title('Original vs Mean Filter');
```

# Image Sharpening

A hand reaching out towards a field of wheat, symbolizing focus and clarity.

**Definition:** Enhances edges and details.

**Effect:** Makes objects or text distinct.

**Purpose:** Highlight important features or improve clarity.

**Example:** Enhancing text in scanned documents

# Types of Sharpening Techniques

A background image showing a person's hand reaching out towards a field of wheat. The hand is positioned on the right side of the frame, with fingers slightly spread. The wheat is in the foreground and background, creating a sense of depth. The overall tone is warm and natural.

1. Laplacian Filter – Detects rapid intensity changes (edges)
2. High-Pass Filter – Preserves high-frequency details
3. Unsharp Masking – Subtracts blurred image to highlight edges

# MATLAB Example: Sharpening

```
l_gray = rgb2gray(I);  
lap_img = l_gray - imfilter(l_gray,  
fspecial('laplacian',0.2));  
unsharp_img =  
imsharpen(l_gray,'Radius',2,'Amount',1);  
imshowpair(l_gray, lap_img,'montage');  
title('Original vs Laplacian Sharpened');
```

# Comparison

- Smoothing: Softens image, reduces noise
- Sharpening: Highlights edges and details
- Both: Preprocessing for image analysis
- Use side-by-side images to compare effects

# Applications

A hand reaching out over a field of wheat. The hand is positioned on the right side of the frame, with fingers slightly spread. The background is a soft-focus field of golden wheat stalks under a bright, hazy sky.

- Smoothing: MRI/CT scans, low-light photography
- Sharpening: Industrial inspection, satellite images
- Combined: OCR, computer vision, edge detection, segmentation

# Summary

- Smoothing reduces noise
- Sharpening enhances edges
- Often used together in preprocessing
- MATLAB functions: `imfilter`, `medfilt2`, `imsharpen`, `fspecial`

# References

- Gonzalez, R.C., & Woods, R.E., Digital Image Processing, 4th Edition, 2018
- MATLAB Documentation:  
<https://www.mathworks.com/help/images>
- Jain, A.K., Fundamentals of Digital Image Processing, 1989